REMARKS

Oath/Declaration and Inventor's Name

The Examiner noted that the signature of inventor Paul R. Stallings does not match the printed name or the name on record, which is Paul H. Stallings. Please correct the record to reflect that the inventor's correct name is Paul R. Stallings as shown by his signature. The incorrect middle initial (H) is a typographical error which appears to have been carried through the application papers inadvertently by both applicants' attorneys and the PTO. The correct middle initial (R) is confirmed by the original oath and declaration, filed March 27, 2000, which include the inventor's full name, Paul Robert Stallings, and his signature as Paul R. Stallings. For the examiner's convenience, a copy of the original oath and declaration with the correct name is attached.

Claims Currently Amended and Pending Claims

Claims 2 and 15 have been amended. Claims 1, 3, 5, 16, 18, 26 and 27 have been cancelled. New claims 28-45 are presented. Claims 2, 7-8, 11-15, 22-25 and 28-45 are now pending in the application.

Section 112 Rejections

Claims 1-25 have been rejected under 35 U.S.C. §112 paragraph 1 as containing subject matter which was not described in such a way as to enable one skilled in the art to make and/or use the invention. The Examiner has objected that transformation function f is a 1x3 vector while composed functions sfl and cfl are shown as 3x1 vectors. Applicant continues to respectfully submit that the written description of transformation function f

and composed functions sfl and cfl are intended to describe standard x,y,z coordinate systems in 3-dimensional computer graphics models and are not intended to represent matrix operations, and that this would be understood by persons of skill in the art. However, to clarify the nomenclature and make it consistent throughout the specification, applicant has amended the specification to make it clear that the equations represent functions and not matrices by, e.g., replacing the square brackets which might have been interpreted as indicating matrices with parentheses, and eliminating expressions that might be mistaken as representing column vectors.

Section 102 Rejections

The Examiner has rejected claims 1-2, 7-8, 11-15 and 22-27 under 35 U.S.C. 102(e) as being anticipated by Silva *et al.* Applicant respectfully traverses this rejection as to now-pending claims 2, 7-8, 11-15 and 22-25. Applicant has amended the independent claims 2 and 15 to further distinguish over Silva.

Applicant has amended claims 2 and 15 by (i) adding the limitation that the resulting solid model is a *procedural* solid model; (ii) adding the limitation that the transformation component permits the definition of arbitrary transformation functions; and (iii) clarifying that the procedural solid modeler supports composed surface and curve geometry functions. Support for the amendments as to a procedural modeler which supports composed surface and curve geometry functions is found throughout the specification, including at page 2, lines 15-21 and page 5, lines 8-11 (the ACIS® Geometric Modeler referenced in the specification is a procedural modeler which supports composed surface and curve geometry functions). Support for the amendments as to

arbitrary transformation functions is also found throughout the specification, including at; page 3, lines 14-20 and page 5, lines 1-2 and 23-25. Claims 2 and 15 have been further amended by adding a limitation to the step of "resetting the geometry" with composed function geometry, which further distinguishes over Silva. Support for this amendment is found at, e.g., page 12, lines 20-22. Claim 2 has been further amended by incorporating therein the limitations of claims 3, 5 and 26. Claim 15 has been further amended by incorporating therein the limitations of claims 16, 18 and 27.

Claims 2 and 15, as amended, recite the step of resetting the geometry of the model by replacing the underlying geometry of each edge, face and/or vertex with surface, curve and/or position geometry represented by new, transformed functions corresponding to the original representing functions. Silva does not teach or suggest such steps. The Examiner states that Silva discloses the step of "creating new surface and curve functions by performing function composition with each of the existing surface and curve functions with the transformation function (derived object 270 is asked by the application control 200 to provide a renderable description of itself, column 11, line 60 through column 12, line 19)." Office Action, page 5, paragraph 10-1. The cited paragraph in Silva is in reality vague as to the explicit mathematical form of the derived object representation. To determine the mathematical form of the derived object representation, reference must be made to the section in Silva on caching, which states: "This embodiment of the invention achieves the speed increase by caching portions of the derived object representation 246...col. 14, line 15 through col. 15, line 9). Silva's statement at column 15, lines 7-8 that "[t]he geometry channel 1220 determines the geometry (e.g., vertices) of the derived

object 270" indicates that the geometry of a face is represented in Silva by a mesh of vertices and edges. In contrast, the result of the claimed step in the present invention is not a mesh but rather a new surface function, which is a parametric function from $\Re^2$ to $\Re^3$. This new surface function is intended to be the new geometry of the face (per the claimed step of "resetting the geometry of the CAD model") and so must be a parametric function from $\Re^2$ to $\Re^3$, rather than a mesh of vertices and edges.

Silva describes a polyhedral modeling system where the geometry consists of control points representing vertices connected by edges, i.e., a mesh. Silva merely describes a transformation technique well-known in the prior art of polyhedral modeling where a transformation is applied directly to control points of the vertices. In contrast, the present invention uses a boundary representation modeling system (or another similar modeling system) where the geometry uses functions representing curves and surfaces. Boundary representation modeling allows for more accurate representations than polyhedral modeling but requires additional computational resources to manipulate. Prior to the present invention, the modeling industry has lacked the ability to accurately and efficiently transform the underlying curves and surfaces of boundary representation models. Polyhedral models as in Silva have topologies (faces and vertices) but not curves or surfaces. Because Silva only discloses transforming mesh points directly, Silva does not disclose or even suggest performing function composition with curve or surface functions.

In other words, the system described by Silva represents surface and curve geometry as a mesh, rather than through functions, and so cannot perform any operation upon the (non-existent) surface and curve functions.

In an effort to find Silva applicable to the invention, the Examiner states that "It is well known that parametric models represent models as sets of procedures having input parameters...." and that "...the underlying parametric equations representing curves or surfaces are implicitly existed (sic) in a parametric definition." However, the meaning of "parametric" in Silva's term "parametric definition" differs from the meaning of the word in applicant's term "parametric function." Silva (at col. 4, lines 50-53) uses the word to refer to parameterizing a family of shapes, e.g., the set of all cylinders with inner radius 1 mm, outer radius 2 mm and height h, where h is the parameter. In the present application, the inventors use "parametric" to refer to parameterizing the domain of the geometry function, i.e., a parameterization (t) of $\Re^1$ for curves or (u,v) of $\Re^2$ for surfaces.

The examiner also relies on Silva's disclosure that "Modifiers can be stacked together so that the output of one modifier is fed into the input of another modifier. This provides the user with a virtually endless number of combinations." Office Action, p. 2, paragraph 14-3. The Examiner suggests that this language applies to functional composition. But even assuming, *arguendo*, that the modifier stack is "composing" in the function composition sense the modifiers functions placed into it, what Silva is describing is the composition of transformation functions from $\Re^3$ to $\Re^3$ with one another to form more general transformations. The "virtually endless number of combinations" to which Silva refers is merely a virtually endless number of modifiers, i.e., transformation functions from $\Re^3$ to $\Re^3$. In contrast, the present invention composes a surface geometry function from $\Re^2$ to $\Re^3$ with a transformation function from $\Re^3$ to $\Re^3$ to form a new surface geometry function from $\Re^2$ to $\Re^3$. The same is true for curves in the present

invention (except that a curve function from $\Re^1$ to $\Re^3$ is composed with a transformation function from $\Re^3$ to $\Re^3$ to form a new curve geometry function from $\Re^1$ to $\Re^3$).

In summary, to the extent that Silva discloses function composition, Silva only composes transformations to make a general transformation function; Silva does not compose surface geometry functions with a transformation to create a new geometry. Likewise, to the extent Silva suggests resetting a geometry, it is only from mesh to mesh, i.e., replacing old vertices with new vertices. As each of the modifiers in the stack is applied, it changes the positions of the nodes of the mesh. In the claimed invention, the geometry is represented by functions, while in Silva it is represented by a mesh. In the claimed invention, the geometry is reset by replacing the original shape function with a new shape function. Thus, the claims, as amended, are allowable over Silva.

Section 103 Rejections

The Examiner has rejected claims 3, 5, 16 and 18 as obvious under 35 U.S.C. §103 in view of Silva over Kalay. These claims have been canceled. However, if the examiner believes that the independent claims into which the limitations of the canceled dependent claims have been incorporated are obvious, Applicant submits that there is no teaching or incentive to combine Silva and Kalay, and even if there were, the combination of Silva and Kalay does not result in the invention. Specifically, the combination does not yield the use of functional composition to obtain new surface and curve geometry functions by composing a transformation with initial surface and curve geometry functions. This is because Kalay does not admit the possibility of procedural, non-polynomial surface functions, such as can arise by composing a surface function with an arbitrary (i.e.,

possibly non-polynomial) transformation. In particular, Kalay states, "The mathematical formulation underlying all the surface representation methods are polynomial functions." (Kalay, page 503, fifth paragraph) Thus, Kalay teaches away from using a composed function to represent geometry. Several of the examples in the specification discuss trigonometric transformation functions, the composition of which with a polynomial surface function cannot be represented by a polynomial surface function. The claims as amended clearly recite the novel, non-obvious idea of composed surface geometry functions of the present invention.

Conclusion

Applicants' attorneys appreciate the courtesy of the examiner in several telephone calls concerning this application.

In view of the foregoing amendments and remarks, Applicants respectfully request that a timely notice of allowance be issued in this case.

Respectfully submitted,

By ________________________
Eric H. Weimers
Reg. No. 33,048

JENNER & BLOCK LLP
One IBM Plaza
Chicago, IL 60611

Writer's Direct Dial: 312-923-2986
Writer's Direct Fax: 312-840-7386
Internet Address: eweimers@jenner.com
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